Quasi-Moseleys law for UTA spectra in high-Z highly ion charge states for high power EUV & soft x-ray sources

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Abstract

Bright narrow band emission observed in optically thin plasmas of high-Z elements in the extreme ultraviolet spectral region follows a quasi-Moseley's law. The wavelength varies from 13.5 nm to 4 nm as the atomic number ranging from 50 to 83. The range of emission wavelengths available from hot optically thin plasmas permits the development of bright laboratory-scale sources for applications including lithography, x-ray microscopy, and x-ray absorption fine structure (XAFS) determination.

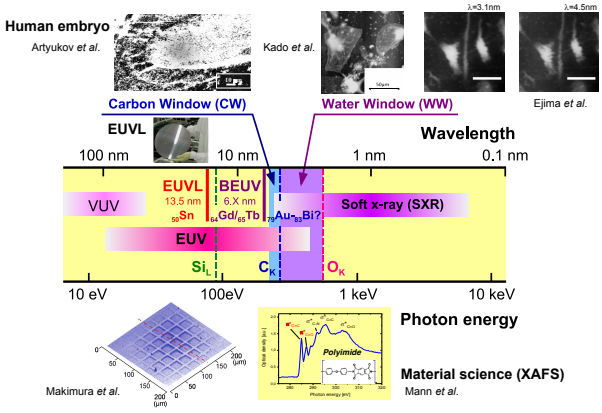
Summary

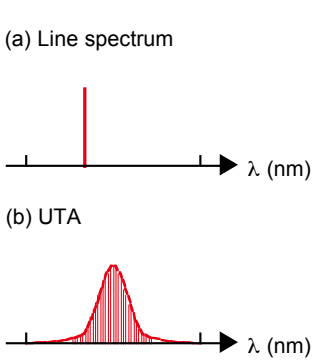
(1) We can select the wavelength of the n = 4-n = 4 (Δn = 4) UTA light source by adequate Z-selection of the target element and tune it by control of the laser intensity.

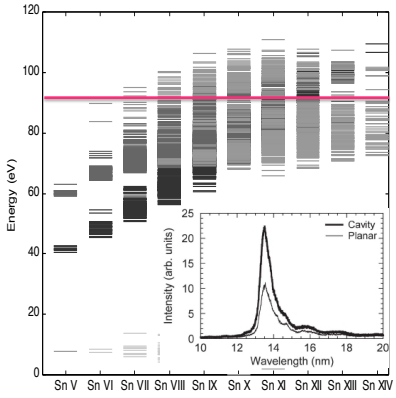
(2) Quasi-Moseley's law is useful for the estimation of appropriate elements.

$$\lambda_{UTA}\ (\mathrm{nm}) = 21.86 \times R_{\infty}^{-1}(Z - 23.23)^{-1.52}$$

Background

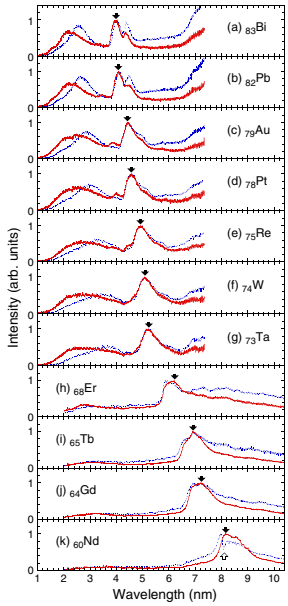




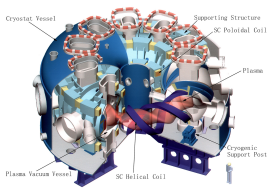


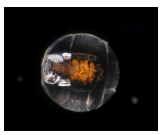
Results

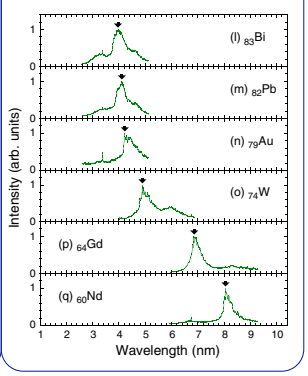
LPPs (150 ps & 10 ns)



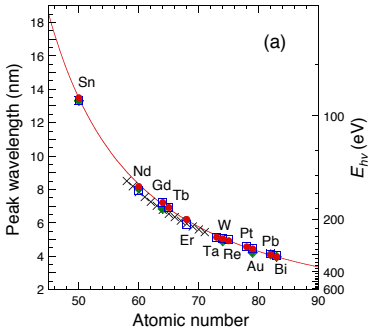
DPPs (LHD@NIFS, Japan)







$$\lambda_{UTA}\ (\mathrm{nm}) = 21.86 \times R_{\infty}^{-1}(Z - 23.23)^{-1.52}$$



- Peak wavelength of n = 4-n = 4 UTAs (λ_{UTA}) depends on the atomic number.
- **Quasi-Moseley's law** was derived from the ps-LPP experimental values.
- UTA peaks of Z = 79-83 were in the water window and Z = 75-79 in the carbon window.
- n = 4-n = 5 UTAs observed in shorter wavelength than n = 4-n = 4 UTAs show the difference between pulse durations due to the difference of charge state distributions in the plasmas.
- Strong self-absorption effect was observed in the case of $_{60}$Nd.

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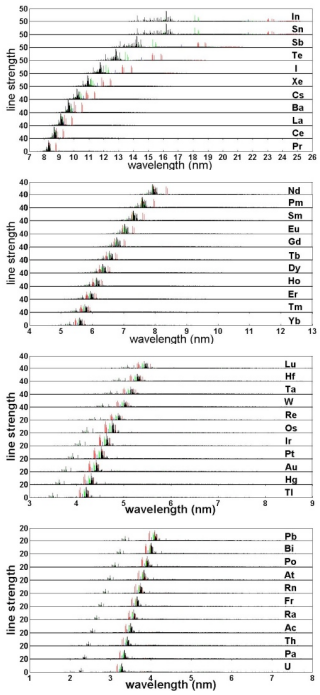
Shorter-wavelength extreme-UV sources below 10nm



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Quasi-Moseley's law for strong narrow bandwidth soft x-ray sources containing higher charge-state ions

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